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ABSTRACT

Intellectual functioning of a lower class kindergarten class exposed to the introduction of a Piaget-oriented curriculum was compared with intellectual functioning of one comparison lower class and one comparison middle class group of children taught in a traditional, activity-centered kindergarten program. Change scores between the beginning and end of a school year were significantly higher for the experimental lower class group on one standardized measure and on several Piagetian tasks. Main features of the Piaget-oriented curriculum and implications of the results are discussed. One-half of the document consists of the bibliography, tables, and summary material. (Author)

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Influences of a Piaget-oriented Curriculum on Intellectual Functioning of Lower-class Kindergarten Children[1,2]

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The substantial work of Jean Piaget and his Genevan associates in developing a broad and highly original theory of intellectual development has had far reaching influences on contemporary behavioral science (Flavell, 1963). Research efforts in the field of child development based on this theory have cascaded in number and variety in the last ten years and have furnished us with new insights regarding the evolution of thought processes. As yet there are a relatively small number of efforts to adapt various aspects of Piagetian theory to the educational enterprise and most of these are the work of British investigators (Lovell, 1961; Lunzer, 1960; and Peel, 1960). In this country Hunt (1961) and Kamii (1970) have been concerned particularly with the application of a framework derived from Piaget's theory as a basis for compensatory education for young children. The pilot study reported here is an effort to translate present findings into classroom practice in one kinder-

PS 004528

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[3]Appreciation is given to Dr. Douglas Penfield for assistance in planning the data analysis.

Objectives

This study was designed to determine what effects, if any, a teacher in a regular public-school kindergarten might have on the thinking of lower-class children using an approach derived from certain pedagogical principles implied in Piaget's theory of the development of thought.[4]

Method

A comparison was made of the thinking abilities of three groups of kindergarten children, one lower-class group exposed to an innovative curriculum, and one lower-class and one middle-class group taught in a traditional, activity-centered program. All three classes were given a battery of mental tests and of Piagetian tasks at the beginning and end of the school year.

Changes introduced in the Piagetian-oriented curriculum included the teacher's shifting her emphasis from reliance on adult-initiated direct instruction to recognition of the importance of the child's learning through his acting on objects and observing and systematizing the results of his actions (Sonquist, Kamii, Derman, 1970). The teacher provided opportunities for the children to classify, seriate, experience number inequivalencies and equivalencies, deal with spatial and temporal concepts, and become familiar with the nature of matter through action on objects. She also emphasized representational knowledge through the three types described by Piaget; use of indices, symbols and words, and language.

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[4]The approach utilized by the teacher was based, in part, on work reported and observed in the Early Education Program, Ypsilanti, Michigan, directed by Dr. Constance Kamii.

Instruments

A battery of standardized measures and non-standardized Piagetian tasks was administered pre- and post in an effort to explore several areas of cognitive functioning. The standardized measures included the following: (a) Columbia Mental Maturity Scale (1959); (b) Boehm Test of Basic Concepts (1969); and (c) Design-copying Tasks (Kamii, 1970).

The Piagetian tasks were based on procedures described by Kamii (1970). These consisted of the following: (a) Classification in which children were given 24 cards varying in color, shape, and size and asked "to put together all those that go together." Three dichotomous sorts were possible; (b) Linear Ordering where ten miniature objects were placed sequentially on a "road" and the child asked "to build a road just like that one"; (c) Reverse Linear Ordering in which the child sees the same display of miniature objects in the same order, but is asked "to make your road again, but this time make it begin at the end and go to the beginning, or make it backwards"; (d) Seriation I in which the child is given an array of ten objects varying systematically in size, watches the examiner arrange them in order from largest to smallest and then disassemble them, and is asked "to put the things together the way I did from the largest to the smallest"; and in Seriation II is then shown the arrangement correctly again and given a set of another ten objects, also varying systematically in size to match with the first set. The child is asked "to give the largest stick to the largest doll, etc."; (e) Conservation in which the classic task of eight red counters is used and the child is asked "to put out enough blue counters so that every red counter has a blue counter to go with it," then the blue counters are bunched closely together, the examiner adds more blue counters so

that the rows of blue and red counters are the same length, and the child is asked "are there still the same number of blue counters as red or are there more or less?"; finally, the child re-establishes correspondence of eight red and eight blue, but the blue row is then spread out by the examiner so that the ends of the two rows are different spatially and the child is asked, "Now, are there more red counters, more blue, or are they the same?"

Subjects

The combined sample consisted of 50 children enrolled in three different kindergarten morning sessions in New Brunswick, New Jersey Public Schools, the two lower-class groups in attendance at one public school, the middle-class group in attendance at a different school. Social class was determined by Hollingshead's Two Factor Index of Social Position (1957, 1958). Children had been enrolled in the school closest to their home, but were randomly assigned to the particular class within the school.

The experimental lower-class group (E-LC) consisted of 20 children (10 boys and 10 girls), all Negro, who attended a school in the inner-city area of New Brunswick. The first comparison group of lower-class children (C-LC) consisted of 17 children (8 boys and 9 girls), also Negro except for one white girl, all of whom attended the same school as the experimental group. The second comparison group, middle-class, (C-MC) consisted of 13 middle-class children (6 boys and 7 girls), all white, who attended a school in suburban New Brunswick.

All children in each class were included in the study except nine not available for both pre- and posttest sessions and two who could not be tested either because of diagnosed mental retardation or inadequate English vocabulary.

PS 004528

Analysis of Data

The three standardized measures were scored according to directions in the manuals. The mean scores for each of the three groups were subjected to an analysis of covariance using the pretest scores in each measure as the covariate for the posttest scores. t-values were obtained for the contrasts in adjusted group means between groups on posttest scores.

The Piagetian measures were scored according to procedures described by Kamii (1970). The results were subjected to a chi-square test of homogeneity to determine differences between groups on the pretest and on the posttest scores. The McNemar test for the significance of changes, K>2 where $\chi^2 = \Sigma\Sigma \frac{(fij - fji)^2}{fij - fji}$, was then applied to obtain a comparison of change scores for each of the three groups and for the three groups as one pooled group.

Results

Tables 1 and 2 show that at the close of the school year the experimental lower-class group (E-LC) scored significantly higher on the Columbia Mental Maturity Scale than did the comparison lower-class group (C-LC) ($p<.05$). The scores of E-LC did not differ significantly from the comparison middle-class group (C-MC), a finding which suggests that the experimental procedures had a positive effect in improving the performance of the lower-class children on this one measure.

Insert Tables 1 and 2 about here

No significant differences were obtained in comparisons of the performance of the three groups on either the Boehm Test of Basic Concepts or the Design-copying Tasks.

Three comparisons were made on the scores obtained by the several kindergarten groups involved in the study on each of the six Piagetian tasks: (a) a comparison of results on the pretest Piagetian task scores; (b) a comparison of results on the posttest Piagetian task scores; and (c) a comparison of change scores made by each group. Results will be reported in the above order.

On the pretest Piagetian task scores two of the six comparisons were significant. Tables 6 and 7 show that Seriation I and II were significant ($p<.01$). No significant differences were obtained on Classification, Linear Ordering, Reverse Linear Ordering, or Conservation, Tables 3, 4, 5, and 8. On the posttest scores one comparison was significant. Table 8 shows a significant difference on Conservation ($p<.05$).

Insert Tables 3 through 8 about here

Application of the McNemar test for the significance of change to compare pre- and posttest scores for the three kindergarten groups and for the pooled groups on each of the six Piagetian tasks revealed the following:

Classification for individual groups was nonsignificant, for the pooled groups it was significant ($\chi^2 = 16.79$, $df = 6$, $p<.05$). On Linear Ordering E-LC made significant gains ($\chi^2 = 7.00$, $df = 1$, $p<.01$) C-LC gained significantly also ($\chi^2 = 6.40$, $df = 1$, $p<.05$) as did C-MC ($\chi^2 = 4.00$, $df = 1$, $p<.05$). The pooled groups showed significant gains as well ($\chi^2 = 19.00$, $df = 1$, $p<.001$).

No significant gains were made by any group or by the pooled groups on Seriation I. The E-LC group showed significant gains on

Reverse Linear Ordering (χ^2 = 5.00, df = 1, p<.05), Seriation II (χ^2 = 15.00, df = 3, p<.01), and Conservation (χ^2 = 8.00, df = 1, p<.01) as did the pooled groups: Reverse Linear Ordering (χ^2 = 4.26, df = 1, p<.05), Seriation II (χ^2 = 25.00, df = 3, p<.001), and Conservation (χ^2 = 11.88, df = 1, p<.001). Gains for C-LC and C-MC were nonsignificant on these measures.

Discussion

In this small sample of kindergarten children the evidence that the experimental lower-class group made significant gains on the processes tapped by the Columbia Mental Maturity Scale and the comparison lower-class and middle-class groups did not appear to be important. It could be inferred that the experimental group benefitted from the type of instruction they had which optimized their action on objects, their invention of relationships, their construction of understandings regarding the physical properties of matter and that these enabled the children to apply their learnings to a non-verbal type of mental test. It further suggests that not only inner-city children but also middle-class children might benefit from the kinds of opportunities the experimental class had.

On the Piagetian tasks which were administered at the beginning of the school year, the cognitive level of the three groups appeared to be similar. According to our data only on the two Seriation tasks was there a significant difference. At the end of the school year the middle-class group scored significantly higher on Conservation than did the two lower-class groups, a result supported by the work of Almy (1968) and deMeuron and Auerswald (1969) who showed that the level of thinking of lower-class children tends to lag behind that of middle-class children from one to three years. Even though the

middle-class children had no systematic preparation for this landmark achievement in the development of logical thought, a combination of the usual advantages of a middle-class environment apparently interacted with school experiences and put these children clearly in the lead on this attainment.

With regard to the gains shown by the three groups from the beginning to the end of the school year on the Piagetian battery, two of the tasks revealed no significant change for any single group, Classification and Seriation I. The fact that the pooled groups made significant gains in Classification suggests that had the individual groups been larger, the gains for them might have been more evident. Results on Seriation I in which neither the individual groups nor the pooled groups showed gains may have been a function of the task having been one of the easier tasks for the children during both pre- and posttest sessions.

Linear Ordering, the second task which children performed with greater ease than they did the others in the battery yielded significant gains for each group and for the pooled groups reflecting clearly that the five-year olds in this study were better able to imitate or reproduce a sequential pattern of objects at the end of kindergarten than they were at the beginning. Since all groups made progress here, it is not clear if our findings reflect a developmental trend or a reflection of common emphasis made by each of the teachers in each classroom.

What is interpreted as the strongest evidence that the innovative features of the kindergarten were, indeed, effective, is shown most clearly on the three most difficult tasks in the Piagetian battery, Reverse Linear Ordering, Seriation II, and Conservation. In these instances, the experimental group made significant gains,

the comparison lower- and middle-class groups did not. This outcome may be said to reflect something of Piaget's position that pedagogical interventions can accelerate or complete spontaneous development, but cannot change the order of constructions (Piaget, 1970). It would also seem to underscore the critical need for approaches to the types of teaching which will help children fill in the lacunae at the preoperational level necessary for them to move toward ability to handle logical thinking.

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Table 1

Analysis of Covariance (Columbia Mental Maturity Scale Pretest) on Posttest Columbia Mental Maturity Scale

	N	Estimated Means		Adjusted Means	S.D. of Adjusted Scores
		C-Pre	C-Post		
E-LC	20	43.15	57.30	57.81	1.93
C-LC	17	38.18	49.59	52.31	2.18
C-MC	13	54.08	61.78	57.42	2.58

Table 2

Comparison of Three Groups on Posttest Scores
Columbia Mental Maturity Scale

E-LC	C-LC	C-MC	df	t
-1.00000	0.0	1.00000	31	-0.11885
0.0	-1.00000	1.00000	28	1.44280
-1.00000	1.0000	0.0	35	-1.90544*

*p<.05

Table 3

Comparison of Three Groups on Pre- and Posttest Piagetian Task Scores (Classification)

	Pretest			Posttest		
	E-LC	C-LC	C-MC	E-LC	C-LC	C-MC
Below Median						
Obtained	16.00	14.00	12.00	9.00	12.00	6.00
Expected	16.80	14.28	10.92	10.80	9.18	7.02
Above Median						
Obtained	4.00	3.00	1.00	11.00	5.00	7.00
Expected	3.20	2.72	2.08	9.20	7.82	5.98

df = 2 df = 2

χ^2 = .94(NS) χ^2 = 2.86(NS)

Table 4

Comparison of Three Groups on Pre- and Posttest Piagetian Task Scores (Linear Ordering)

	Pretest			Posttest		
	E-LC	C-LC	C-MC	E-LC	C-LC	C-MC
Below Median						
Obtained	9.00	10.00	4.00	2.00	2.00	1.00
= Expected	9.20	7.82	5.98	2.00	1.70	1.30
Above Median						
Obtained	11.00	7.00	9.00	18.00	15.00	12.00
Expected	10.80	9.18	7.02	18.00	15.30	11.70

df = 2 df = 2

χ^2 = 2.35(NS) χ^2 = 0.14(NS)

Table 5

Comparison of Three Groups on Pre- and Posttest Piagetian Task Scores (Reverse Linear Ordering)

	Pretest			Posttest		
	L-LC	C-LC	C-MC	E-LC	C-LC	C-MC
Below Median						
Obtained	12.00	10.00	3.00	7.00	7.00	2.00
Expected	10.20	8.16	6.63	6.67	5.67	4.67
Above Median						
Obtained	8.00	6.00	10.00	13.00	10.00	11.00
Expected	9.80	7.84	6.37	13.33	11.33	9.33

df = 2 χ^2 = 5.55(NS)

df = 2 χ^2 = 1.39(NS)

Table 6

Comparison of Three Groups on Pre- and Posttest Piagetian Task Scores (Seriation I)

	Pretest			Posttest		
	E-LC	C-LC	C-MC	E-LC	C-LC	C-MC
Below Median						
Obtained	13.00	5.00	2.00	4.00	3.00	1.00
Expected	8.00	6.80	5.20	3.20	2.72	2.08
Above Median						
Obtained	7.00	12.00	11.00	16.00	14.00	12.00
Expected	12.00	10.20	7.80	16.80	14.28	10.92
	df = 2			df = 2		
	$\chi^2 = 9.28$*			$\chi^2 = 0.94$(NS)		

*$p<.01$

Table 7

Comparison of Three Groups on Pre- and Posttest Piagetian Task Scores (Seriation II)

	Pretest			Posttest		
	E-LC	C-LC	C-MC	E-LC	C-LC	C-MC
Below Median						
Obtained	17.00	10.00	4.00	9.00	5.00	1.00
Expected	12.40	10.54	8.06	6.00	5.10	3.90
Above Median						
Obtained	3.00	7.00	9.00	11.00	12.00	12.00
Expected	7.60	6.46	4.94	14.00	11.90	9.10

df = 2 $\chi^2 = 9.95$*

df = 2 $\chi^2 = 5.23$(NS)

*$p<.01$

Table 8

Comparison of Three Groups on Pre- and Posttest Piagetian Task Scores (Conservation)

	Pretest			Posttest		
	E-LC	C-LC	C-MC	E-LC	C-LC	C-MC
Below Median						
Obtained	18.00	14.00	7.00	10.00	11.00	3.00
Expected	15.20	12.92	9.88	9.60	8.16	6.24
Above Median						
Obtained	2.00	3.00	6.00	10.00	6.00	10.00
Expected	4.40	3.74	2.86	10.40	8.84	6.76

df = 2 df = 2

$\chi^2 = 4.56$(NS) $\chi^2 = 6.21$*

*$p<.05$

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Summary of Tasks

A. Standardized Measures

B. Piaget-derived Measures

Summary of Results

C. t-test of posttest scores adjusted by analysis of covariance (pretest as covariate)

D. χ^2 test of homogeneity on pretest and posttest scores on Piaget tasks

E. McNemar test for significance of change between pre- and posttest scores on Piaget tasks

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[1]Summary of paper presented at the meeting of the American Educational Research Association, New York, February, 1971.

A. Standardized Measures

1. Columbia Mental Maturity Scale. New York: Harcourt, Brace and World, 1959.

Pictorial type classification test utilizing perceptive discriminations, color, shape, size, use, number, kind, missing parts, and symbolic material.

2. Boehm Test of Basic Concepts. New York: Psychological Corporation, 1969.

Picture test designed to appraise young child's mastery of concepts commonly found in preschool and primary grade instructional materials.

3. Design-copying Tasks. Evaluating pupil learning in preschool education: Socio-emotional, perceptual-motor, and cognitive objectives. In B. S. Bloom, J. T. Hastings, and G. Madaus (Eds.), Formative and summative evaluation of student learning. New York: McGraw-Hill, 1970.

Child is given a series of designs on cards, one at a time, and asked to "draw one just like this."

B. Piaget-derived Measures*

1. Classification

Children are given 24 cards varying in three attributes, color (red and blue); shape (circles and squares); size (large and small) and given three opportunities to put together what goes together.

2. Linear Ordering

Ten miniature objects are placed sequentially, one by one, on a "road" and the child asked to build one just like it.

*Adapted from Kamii, C. Evaluating pupil learning in preschool education: Socio-emotional, perceptual-motor, and cognitive objectives. In B. S. Bloom, J. T. Hastings, and G. Madaus (Eds.), Formative and summative evaluation of student learning. New York: McGraw-Hill, 1970.

3. Reverse Linear Ordering

Child views the original array of sequential objects placed on the "road" by the examiner and is asked to make his road again, but this time make it in reverse, beginning (examiner points) at the end of the road and going to the beginning. Examiner assists in setting up the first two objects of the reverse order.

4. Seriation I

Child is given an array of ten identical objects varying systematically only in size from large to small. Examiner organizes the array in front of the child from the largest to the smallest, disassembles it, and asks the child to put it back together from the largest to the smallest. If the child cannot assumble ten objects, he is given the opportunity of seriating five, if he cannot do this, then three objects.

5. Seriation II

Examiner rearranges the same array used in Seriation I correctly from the largest to the smallest. Examiner then gives the child a new set of seriated objects saying to the child, "Give the largest stick to the largest doll, on down to the smallest stick to the smallest doll."

6. Conservation

The child is first asked to place on the table as many blue counters as there are red counters arrayed in a linear fashion on the table. The examiner queries, "Are there more blue, more red, or are they the same?" Examiner then bunches together the blue counters, but adds more so the line corresponds at the end points with the red counters. Examiner asks the same question as above. Examiner then spreads out the eight counters again, child re-establishes blue counters to match the red ones. Same question is asked. Then the examiner spreads the red counters further apart, so that the end points of the array of red counters no longer correspond to the end points of the blue counters. Child is asked the same question as above.

Summary of Results

C. t-test of posttest scores adjusted by analysis of covariance (pretest as a covariate)

	Standardized Measures	Experimental Lower-class	Comparison Lower-class	Comparison Middle-class
†Table 1, 2	Columbia Mental Maturity	*	NS	NS
	Boehm Test Basic Concepts	NS	NS	NS
	Design-copying Tasks	NS	NS	NS

D. χ^2 test of homogeneity

	Piagetian Tasks	Pretest	Posttest
		Scores	
†Table 3	Classification	NS	NS
†Table 4	Linear Ordering	NS	NS
†Table 5	Reverse Linear Ordering	NS	NS
†Table 6	Seriation I	**	NS
†Table 7	Seriation II	**	NS
†Table 8	Conservation	NS	*

E. McNemar test for significance of change between pre- and posttest scores

$$\chi^2 = \Sigma\Sigma\frac{(fij - fji)^2}{fij - fji}$$

	Piagetian Tasks	Experimental Lower-class	Comparison Lower-class	Comparison Middle-class	Pooled Groups
†Table 3	Classification	NS	NS	NS	*
†Table 4	Linear Ordering	**	*	*	***
†Table 5	Reverse Linear Ordering	*	NS	NS	*
†Table 6	Seriation I	NS	NS	NS	NS
†Table 7	Seriation II	**	NS	NS	***
†Table 8	Conservation	**	NS	NS	***

*p<.05
**p<.01
***p<.001

†References are to tables in original copy of paper, available on request.